

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. **(currently amended)** A pumping system for ~~powder (54), in particular for coating powders, containing~~ comprising at least one powder pump ~~(2-1, 2-2) fitted with~~ comprising:
a metering chamber (4-1, 4-2) which is bounded by a chamber housing; (6-1, 6-2) and
an expelling element ~~(8-1, 8-2), said expelling element~~ which is forward-displaceable relative to the chamber housing during a pressure stroke and backward during a suction stroke; ~~[[,]]~~
the ~~[[pump]]~~ metering chamber comprising:
a powder intake duct ~~(36-1, 36-2)~~ associated with a powder intake valve ~~(38-1, 38-2), further~~
a powder outlet duct (40-1, 40-2) associated with a powder outlet valve ~~(42-1, 42-2), and~~
a compressed gas intake duct ~~(44-1, 44-2)~~ associated with a compressed gas intake valve ~~(46-1, 46-2),~~
the powder intake valve ~~(38-1, 38-2)~~ being opened to aspirate a metered quantity of powder ~~[[(54)]]~~ into the metering chamber ~~(4-1, 4-2)~~ and while the powder outlet valve ~~(42-1, 42-2)~~ and the compressed gas intake valve ~~(46-1, 46-2)~~ being closed, whereby a movement of the expelling element ~~moving~~ in the direction of the suction stroke aspirates ~~is able to aspirate~~ powder ~~[[(54)]]~~ through the powder intake duct ~~(36-1, 36-2)~~ into the metering chamber (4-1, 4-2), and
the powder intake valve ~~(38-1, 38-2)~~ being closed in order to convey the metered quantity of powder out of the metering chamber (4-1, 4-2), and while the

powder outlet valve (42-1, 42-2) and the compressed gas intake duct (44-1, 44-2) are opened, as a result of which compressed gas flowing from the compressed gas intake duct (44-1, 44-2) is able to force the metered quantity of powder from the metering chamber (4-1, 4-2) into the powder outlet duct; (40-1, 40-2), and said pump system further comprising a pump control unit [(68)] to drive the compressed gas intake valve; (46-1, 46-2),

characterized in that wherein

the pump control unit [(68)] comprises a time controller [(74)] by means of which ~~the conveyance of powder out of the metering chamber (4-1, 4-2) is initiated as a function of the a~~ predetermined delay time is counted ~~elapsed~~ since a predetermined operational point, the compressed gas being introduced at the end of the [[time]] delay time into the metering chamber (4-1, 4-2) and the quantity of powder metered until the end of the [[time]] delay time is forced by the compressed gas out of the metering chamber (4-1, 4-2).

2. **(currently amended)** The pump [Pump] system as claimed in claim 1, further comprising a reversal device for reversing the motion of the expelling element from the suction stroke to the pressure stroke and vice-versa, characterized in that wherein

the pump control unit [(68)] comprises a timer and transmits control signals, each [[time,]] upon the lapse of a predetermined cycle time counted by said timer, ~~to control signals to a the~~ reversal device [(34)] to reverse the motion of the expelling element (8-1, 8-2) from the suction stroke to the pressure stroke [[and]] or vice-versa; and from pressure stroke to suction stroke at the predetermined cycle time, and in that

the pump control unit [(68)] is configured ~~designed~~ to initiate at the time controller [(74)] the predetermined delay time each time one of the control signals is generated to initiate as ~~a function of the time that control signal was generated which initiates~~ the beginning of the suction stroke, ~~the compressed gas being introduced at the end of said time delay into the metering chamber (4-1, 4-2) And the quantity of powder that was metered until the end of the delay time being forced~~

out of the metering chamber (4-1, 4-2) by the compressed gas.

3. **(currently amended)** The pump [[Pump]] system as claimed in claim [[1]] 2, further comprising ~~characterized by~~ at least one monitoring sensor for ~~(S5, S6)~~ detecting when the expelling element ~~(8-1, 8-2)~~ is at a predetermined position and generating a sensor signal upon detecting that the expelling element is in the predetermined position; [[, by]]

wherein the pump control unit is ~~(68) being~~ operationally connected to said at least the ~~minimum of one monitoring sensor, and by the pump control unit(68) being designed~~ is configured to automatically compare the time of the sensor signal with the time of at least one of the ~~monitoring~~ control signals to deduce whether ~~[[the]]~~ a time interval between said two times deviates from a predetermined value, and to generate ~~by generating~~ an error signal when the time interval does deviate from the predetermined value ~~a predetermined deviation from the predetermined values does arise.~~

4. **(currently amended)** The pump [[Pump]] system as claimed in claim 1, further comprising ~~characterized in that there are~~ at least two monitoring sensors ~~(S5, S6)~~ which are connected to the pump control unit ~~[[68]]~~ to detect when the expelling element ~~(8-1, 8-2)~~ is situated in one of two different predetermined positions, respectively, and to generate sensor signals when detecting the expelling element in the predetermined positions, respectively; ~~and in that~~

wherein the pump control unit ~~[[68]]~~ is designed configured to compare ~~[[the]]~~ a time difference between the sensor signals from one of the monitoring ~~sensors~~ sensor and the sensor signals from the other monitoring sensor on one hand and a predetermined time interval on the other hand, and to generate an error signal when the time difference deviates from the predetermined time interval by more than a predetermined value.

5. **(currently amended)** The pump [[Pump]] system defined in claim 1, characterized in that wherein the predetermined operational point corresponds to a predetermined suction stroke

~~position of the expelling element during the suction stroke the pump control unit (68) comprises a time controller (74) to initiate powder conveyance — as a function of the predetermined delay time elapsed after a predetermined suction stroke position of the expelling element (8-1, 8-2) — out of the metering chamber, compressed gas being introduced at the end of the time delay into the metering chamber (4-1, 4-2) and the quantity of powder metered until the end of the delay time being forced by the compressed gas out of the metering chamber (4-1, 4-2).~~

6. **(currently amended)** The pump [[Pump]] system as claimed in claim 5, ~~characterized in that~~ wherein the predetermined suction stroke position is a suction stroke initial position.

7. **(currently amended)** The pump [[Pump]] system as claimed in claim 5, ~~characterized in that~~ wherein the predetermined suction stroke position is situated between a suction stroke initial position and a suction stroke final position.

8. **(currently amended)** The pump [[Pump]] system as claimed in claim 5, ~~characterized in that~~ wherein the predetermined suction stroke position is situated between a suction stroke initial position and a suction stroke final position, nearer the former than the latter.

9. **(currently amended)** The pump [[Pump]] system as claimed in claim 5, ~~characterized in that~~ further comprising:

~~the time controller (74) comprises at least one sensor connected to the time controller (S1, S4; S2, S3) to generate a sensor signal when the expelling element (8-1, 8-2) is situated in [[a]] the predetermined suction stroke position.~~

10. **(currently amended)** The pump [[Pump]] system as claimed in claim 5, further comprising:

a reversal device controlled by the pump control unit for reversing the motion of the expelling element from the suction stroke to the pressure stroke and vice-versa; and characterized in that it comprises a pump control unit (68) implementing the reversal of motions of the expelling element (8-1, 8-2) from suction stroke to pressure stroke and vice versa as a function of signals from

two sensors coupled to said pump control unit, each said sensors for generating a sensor (S1, S4) each of which generates a signal when the expelling element (8-1, 8-2) is situated along the stroke excursion at either at one of two predetermined motion reversal positions, said sensor signal causing said pump control unit to control the reversal device to reverse the motion of the expelling element.

11. **(currently amended)** The pump [[Pump]] system as claimed in claim 1, ~~characterized in that~~ wherein the excursion of the expelling element (8-1, 8-2) is constantly the same size for all stroke displacements.

12. **(currently amended)** The pump [[Pump]] system as claimed in claim 1, further comprising:

a reversal device controlled by the pump control unit for reversing the motion of the expelling element from the suction stroke to the pressure stroke and vice-versa; characterized in that

wherein said pump control unit is configured to take a second [[time]] delay time takes place at least at one of the motion reversal positions dead points of the expelling element (8-1, 8-2) before the expelling element (8-1, 8-2) having moved in one direction is moved by the reversal device in the opposite pertinent other direction.

13. **(currently amended)** The pump [[Pump]] system as claimed in claim 1, ~~characterized in that~~ wherein the [[time]] delay time is variably adjustable.

14. **(currently amended)** The pump [[Pump]] system as claimed in claim 1, ~~characterized in that~~ wherein the expelling element ~~(8-1, 8-2)~~ is a flexible membrane.

15. **(currently amended)** The pump [[Pump]] system as claimed in claim 1, ~~characterized in that~~ wherein the powder intake valve ~~(38-1, 38-2)~~ and the powder outlet valve ~~(42-1, 42-2)~~ are automatic valves which are automatically opened and [[resp.]] closed by the pressure differential across opposite ~~their two valve sides~~ of each said valves.

16. **(currently amended)** The pump [[Pump]] system as claimed in claim 15, ~~characterized in that~~ wherein each of the powder intake valve ~~(38-1, 38-2)~~ and the powder outlet valve ~~(42-1, 42-2)~~ ~~are automatic valves actuated in the manner of~~ is a check valve comprising: by differential gas pressure across their valve element ~~(38-3, 42-3)~~, said
a valve seat; and

a valve element which is ~~(38-3, 42-3)~~ being displaceable as a function of said ~~this~~ gas pressure differential relative to [[a]] the valve seat (38-4, 42-4) into [[its]] an open or a ~~into its~~ closed position ~~and can be latched into said particular position~~.

17. **(currently amended)** The pump [[Pump]] system as claimed in claim 15, ~~characterized in that~~ wherein each of the powder intake valve ~~(38-1, 38-2)~~ and the powder outlet valve includes a hollow valve element that ~~(42-1, 42-2)~~ ~~are automatic valves of the duck bill kind of which the duck bill~~ automatically opens [[resp.]] or closes on account of the pressure ~~difference~~ differential between the inside and the outside of the ~~duck bill~~ valve element.

18. **(currently amended)** The pump [[Pump]] system as claimed in claim 1, ~~characterized in that~~ comprising at least two of the said powder pumps; ~~(2-1, 2-2)~~ are used, their
wherein

the powder intake ducts of the power pump are ~~(36-1, 36-2) being connected or connectable~~ to a powder source and ~~[[their]]~~ the powder outlet ducts of the power pump are ~~(40-1, 40-2) being connected or connectable~~ to a common powder feed aperture; ~~[[48),]]~~ and ~~in that the two~~

said powder pumps ~~(2-1, 2-2)~~ are ~~operated~~ operable in tandem ~~opposition~~ whereby a metered quantity of powder ~~is may be~~ expelled in alternating manner from the metering chamber ~~[[4-1]]~~ of one powder pump ~~[[2-1]]~~ or from the metering chamber ~~[[4-2]]~~ of the other powder pump ~~[[2-2]]~~, by means of the compressed gas, into the respective powder outlet duct ~~(40-1, 40-2)~~, and reversely, powder ~~[[may be]]~~ is alternately aspirated through the powder intake ducts ~~(36-1, 36-2)~~ of said powder pumps into the respective ~~either of the other~~ metering chambers ~~chamber~~ ~~(4-1, 4-2)~~

19. **(currently amended)** The pump ~~[[Pump]]~~ system as claimed in claim 18, ~~characterized in that~~ wherein the expelling elements ~~element~~ ~~(8-1, 8-2)~~ of the pumps are actuated by a common drive ~~[[10)]]~~.

20. **(currently amended)** A powder ~~Powder~~ coating apparatus, comprising: ~~characterized by~~
a powder spraying device for spraying coating powder onto an object to be coated; and
a pump system as claimed in claim 1 ~~at least one of the above claims~~ to convey coating powder to said powder spraying device.

21. **(currently amended)** A method of ~~Method for~~ conveying powder ~~(54), in particular~~ coating powder, said method comprising the steps of: wherein
aspirating powder, ~~(54) is aspirated~~ by increasing the volume of a metering chamber, ~~(4-1, 4-2)~~ from a power source into ~~[[this]]~~ said metering chamber, ~~(4-1, 4-2)~~ and ~~thereupon~~
after said aspirating, expelling the metered quantity of powder, ~~is forced~~ by means of compressed gas, out of the metering chamber ~~(4-1, 4-2)~~, thereupon the volume of the metering

chamber (4-1, 4-2) being decreased and [[next]] the cycle of said aspirating and expelling steps being periodically repeated,

~~characterized in that wherein~~

during said aspirating, a predetermined phase of the periodic change in volume of the metering chamber (4-1, 4-2) is detected; ~~by sensors (S1, S4; S2, S3) and in that employing~~

said expelling is initiated with a predetermined [[time]] delay time after the predetermined phase has been reached, whereby the quantity of powder metered up to that time is forced out of the metering chamber (4-1, 4-2) by means of the compressed gas.

22. **(currently amended)** The method Method as claimed in claim 21, ~~characterized in that further comprising:~~

using at least one valve ~~is used in the particular path~~ in each of a powder intake duct (36-1, 36-2) into the metering chamber and [[in]] a powder outlet duct (40-1, 40-2) out of the metering chamber (4-1, 4-2), said valve automatically opening and closing ~~in the manner of a check valve as~~ a function of the ~~particular gas~~ pressure difference between an ~~said at least one valve's~~ upstream side and a downstream side of said at least one valve.

23. **(currently amended)** A method of Method ~~for conveying powder (50), in particular coating powder, said method comprising the steps of:~~

aspirating powder wherein, by enlarging the volume of at least one metering chamber (4-1, 4-2), ~~powder (54) is aspirated~~ from a powder source into the metering chamber; (4-1, 4-2) and ~~thereupon~~

after said aspirating, expelling the metered quantity of powder ~~is forced~~ out of the metering chamber (4-1, 4-2) by compressed air, the volume of the metering chamber (4-1, 4-2) then being decreased and [[next]] the cycle of said aspirating and expelling steps will be repeated periodically,

~~characterized in that wherein~~

the volume changes of the at least minimum ~~of~~ one metering chamber (4-1, 4-2) are

controlled by a predetermined cycle time, ~~in that~~

following lapse of the predetermined cycle time, ~~in each case~~ at least one control signal is generated to reverse ~~shall be generated, in that this minimum of one control signal reverses the~~ direction of volume change from enlarging to decreasing or vice versa ~~resp. from decreasing to enlarging~~ and, simultaneously, a predetermined [[time]] delay time is initiated, and ~~in that~~

only when the predetermined [[time]] delay time has lapsed shall the metered quantity of powder be forced by the compressed gas out of the metering chamber.

24. **(currently amended)** The method ~~Method~~ as claimed in claim 23, ~~characterized in that wherein~~

the volume changes of the at least ~~minimum of~~ one metering chamber (4-1, 4-2) are implemented by an expelling element (8-1, 8-2), ~~in that~~

the presence of the expelling element in a predetermined position is determined by at least one monitoring sensor (~~S5, S6~~) and a monitoring signal is generated when the expelling element is detected in [[a]] the predetermined position, and ~~in that~~

the time difference between the time of the ~~control~~ monitoring signal and the time of the at least ~~minimum of~~ one control signal is compared with a predetermined time interval which is ~~would be the time difference expected~~ if the expelling element completes ~~were to cover~~ a predetermined excursion within each cycle time, and ~~in that~~

an error signal is generated when the gap between the time difference and the predetermined time interval exceeds a predetermined value.

25. **(currently amended)** The method ~~Method~~ as claimed in claim 23, ~~characterized in that wherein~~

the volume changes of the at least ~~minimum of~~ one metering chamber are implemented by an expelling element (8-1, 8-2), ~~in that~~

monitoring signals are generated by ~~means of~~ at least two monitoring sensors (~~S5, S6~~)

~~which are configured mutually apart along a path corresponding to the maximum excursion of~~
~~when the expelling element respectively when it assumes two predetermined end positions~~
~~corresponding to a maximum and a minimum of said volume~~ a position corresponding to the sensor
~~position, in that~~

the time difference between the monitoring signals of one monitoring sensor and the monitoring signals of the other monitoring sensor is compared with a predetermined time interval which ~~is~~ would be the magnitude of the time difference expected if the expelling element completes a travel between said end positions ~~were to cover were to move along a predetermined nominal path~~ within the cycle time, and ~~in that~~

an error signal ~~shall be~~ is generated whenever the said time difference deviates by more than a predetermined value from the predetermined time interval.

26. **(currently amended)** The method ~~Method~~ as claimed in claim 21, ~~characterized in that~~ comprising:

using, in tandem, two of the metering chambers ~~(4-1, 4-2)~~ that undergo volume changes simultaneously but at different phases, the volume of one metering chamber being enlarged while the volume of the other metering chamber is decreased, and vice-versa.